

# EPA GROUND WATER INVESTIGATION

San Mateo Creek Basin Uranium Legacy Site  
Tronox NAUM Ambrosia Lake Impact Area

November 15, 2016 Meeting

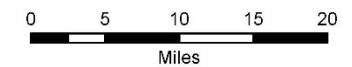
# Legacy of Uranium Mining in Northwestern New Mexico



- Uranium Mine
- ▲ Mill Location
- City or Town
- ▭ Uranium Sub-District
- ▭ Pueblo of Acoma
- ▭ Pueblo of Laguna
- ▭ Navajo Nation Chapter
- ▭ Navajo Nation Ownership
- ▭ San Mateo Basin
- ▭ NPL Site
- ▭ County
- Land Ownership for Tracts with Mines
- ▭ Bureau of Land Management
- ▭ Forest Service
- ▭ Tribal Land
- ▭ Private Land
- ▭ State Land

Note:  
The Land Ownership layer as displayed is not complete.  
The only areas displayed are those containing one or more mines.

Sources:  
MMD Legacy Uranium Mine Inventory: 12/2008.  
EPA Region 6 National Priorities List (NPL), 5/2015.  
Bureau of Land Management (BLM) Land Ownership.  
Navajo Land Department 2016, Census Bureau 2000  
TIGER/Line, ESRI World Shaded Relief.

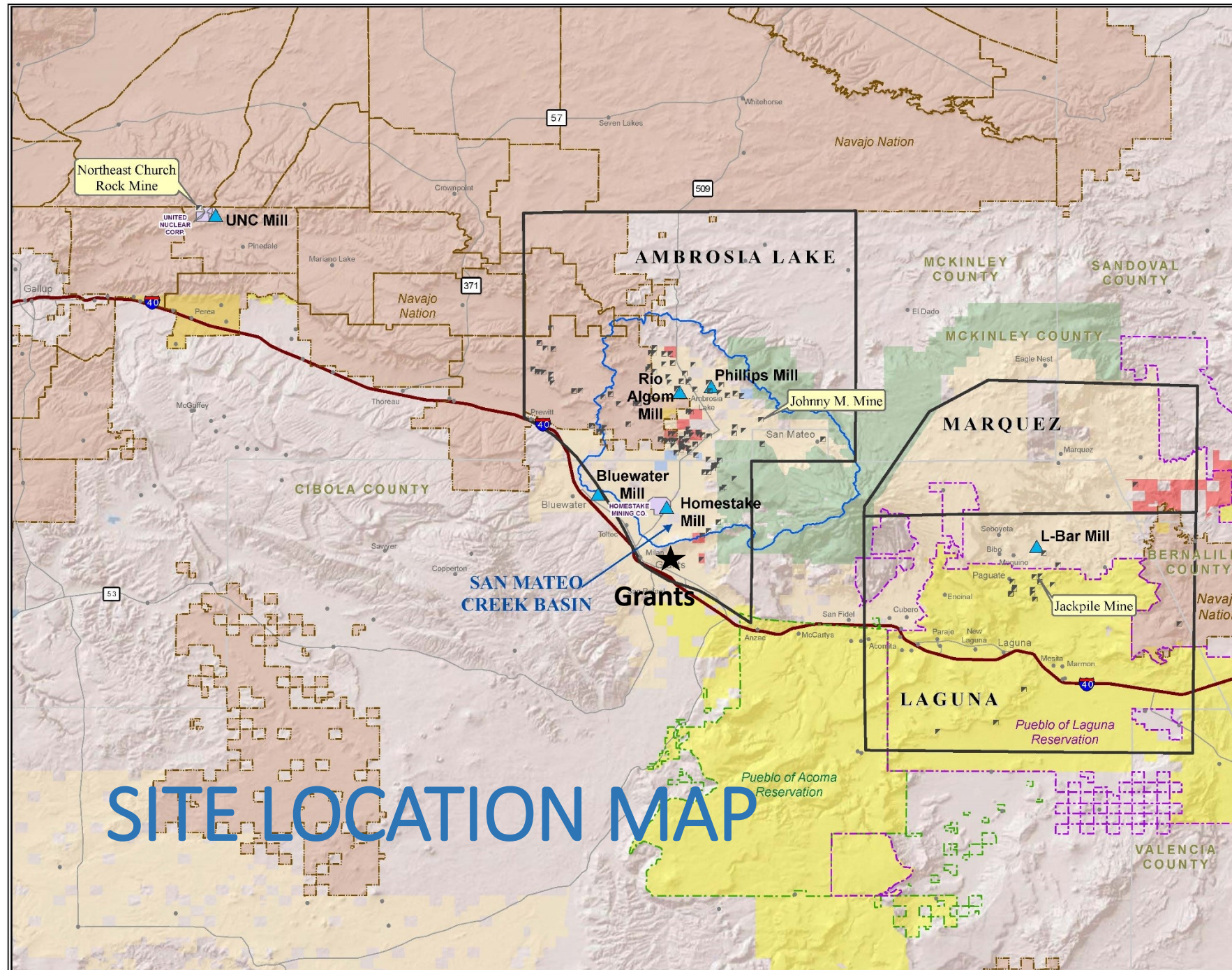


EPA Region 6  
Superfund  
GIS Support  
04/25/2016



20160425MLO1

## SITE LOCATION MAP





# SITE MAP

San Mateo Creek  
Basin

Phillips  
Mill

Rio Algom  
Mill

Arroyo del Puerto

San Mateo

DOE Anaconda  
Bluewater  
Mill Site

Homestake Mill  
NPL Site

321 Square Miles

MT. TAYLOR

Milan

# PROJECT OBJECTIVE

Investigate legacy uranium mining and milling impacts to ground water





# MULTI-PHASED INVESTIGATION

## *Phase 1*

*Alluvial Aquifer  
San Mateo Creek Basin  
2012 – 2016*



## *Phase 2*

*Bedrock & Alluvial Aquifers  
Tronox NAUM Ambrosia  
Lake Impact Area  
2015 – 2017*



## *Phase 3*

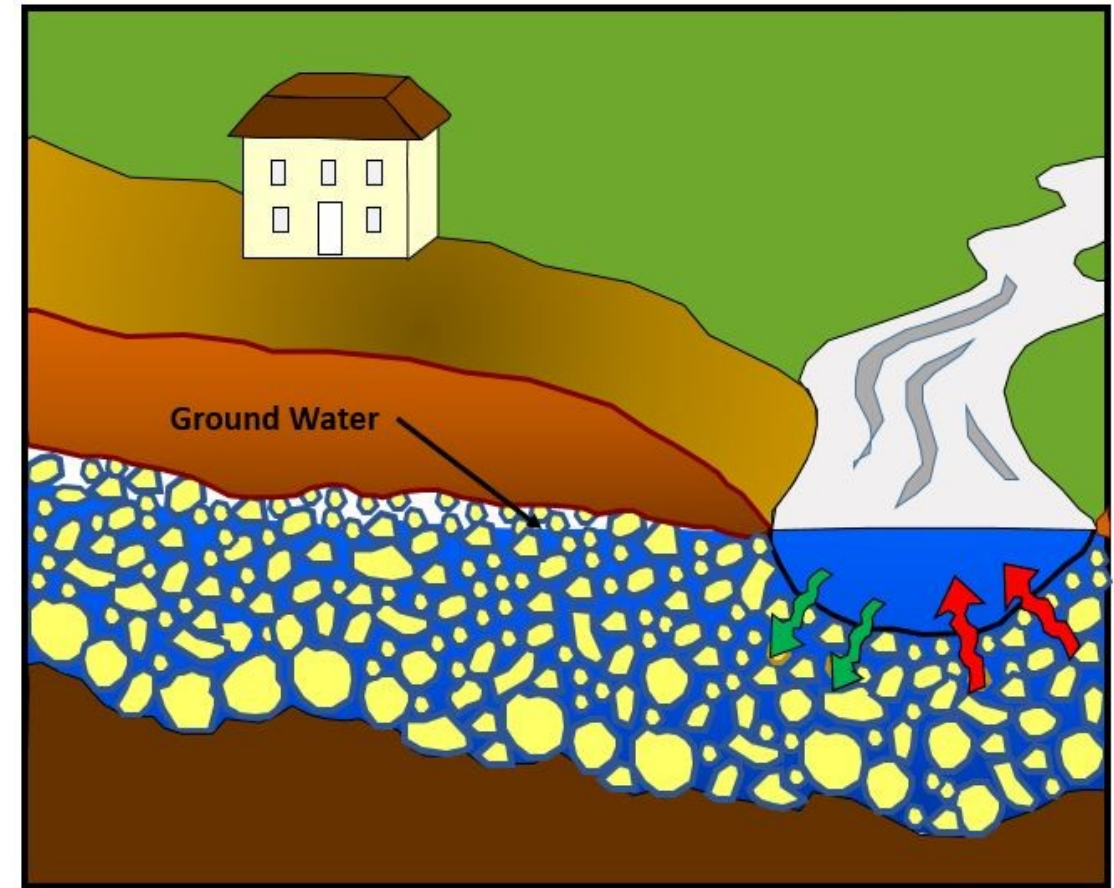
*Develop Conceptual Site  
Model for Tronox NAUM  
Impacts  
2016 - 2018*



# PRELIMINARY CONCEPTUAL SITE MODEL

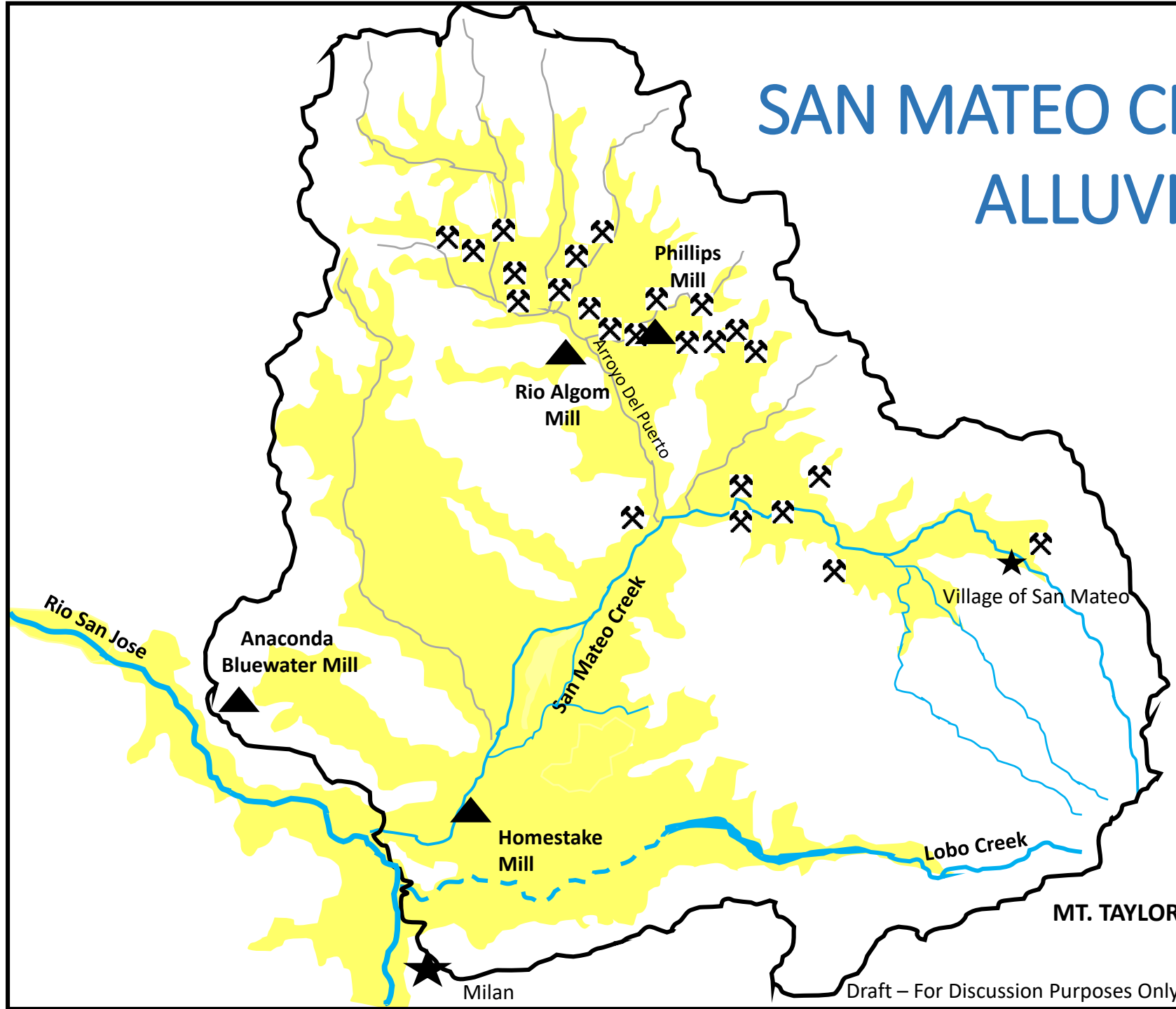
## What Do We Need to Know?

- Alluvial Aquifer
  - Where are the alluvial sediments?
  - Where is the ground water?
  - What is direction of flow?
- Bedrock Aquifers
  - What is the underlying bedrock hydrogeology?
  - What is the hydraulic relationship between alluvial and bedrock aquifers?



Modified from City of Las Cruces  
Poster Display

# SAN MATEO CREEK BASIN ALLUVIUM



■ Alluvium

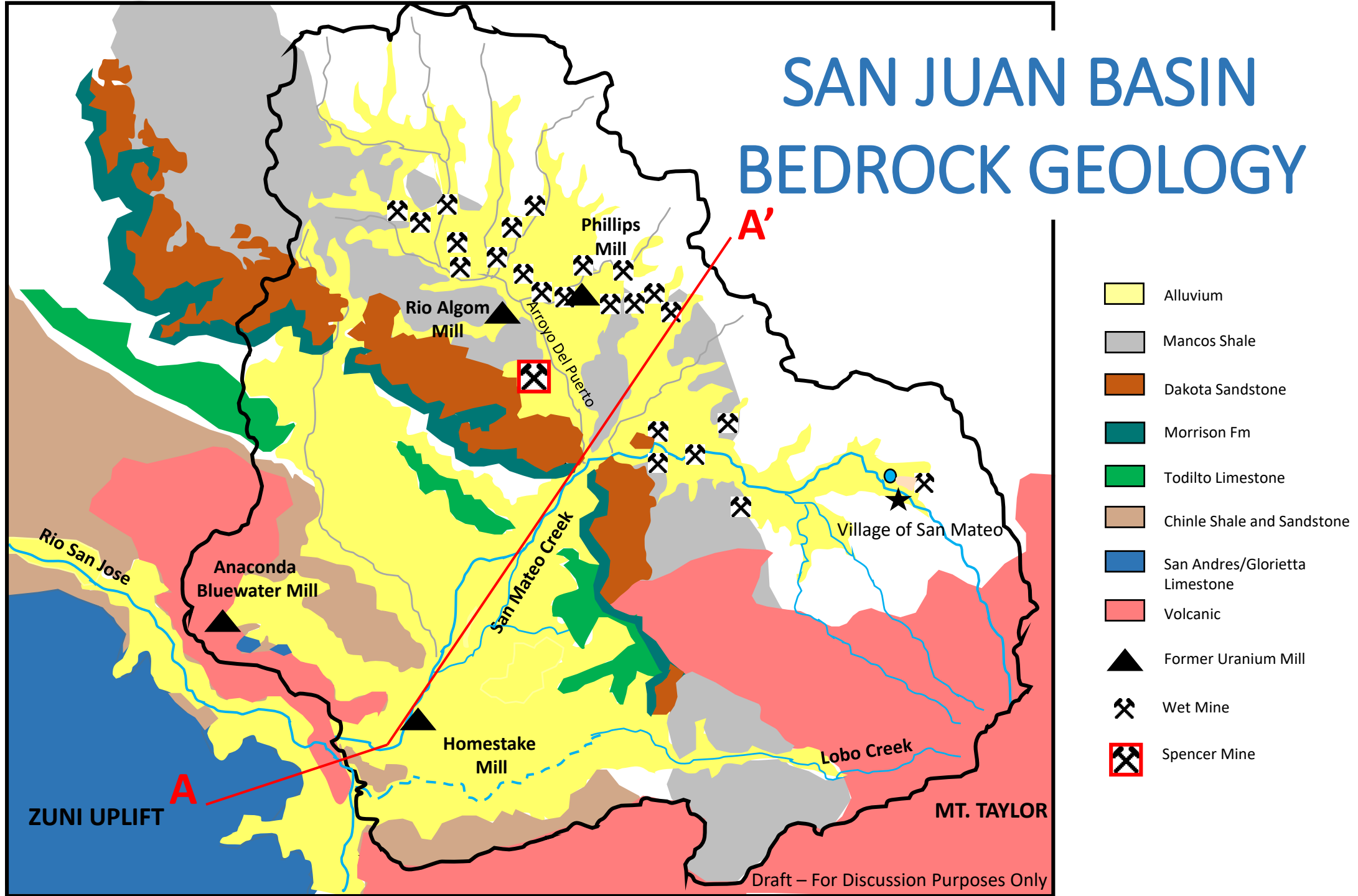
✕ Wet Mine

## *ALLUVIUM:*

*Sediments  
Deposited in  
Basin from  
Erosional  
Processes;*

*Comprised of  
Sand, Silt, Clay  
and Gravel*

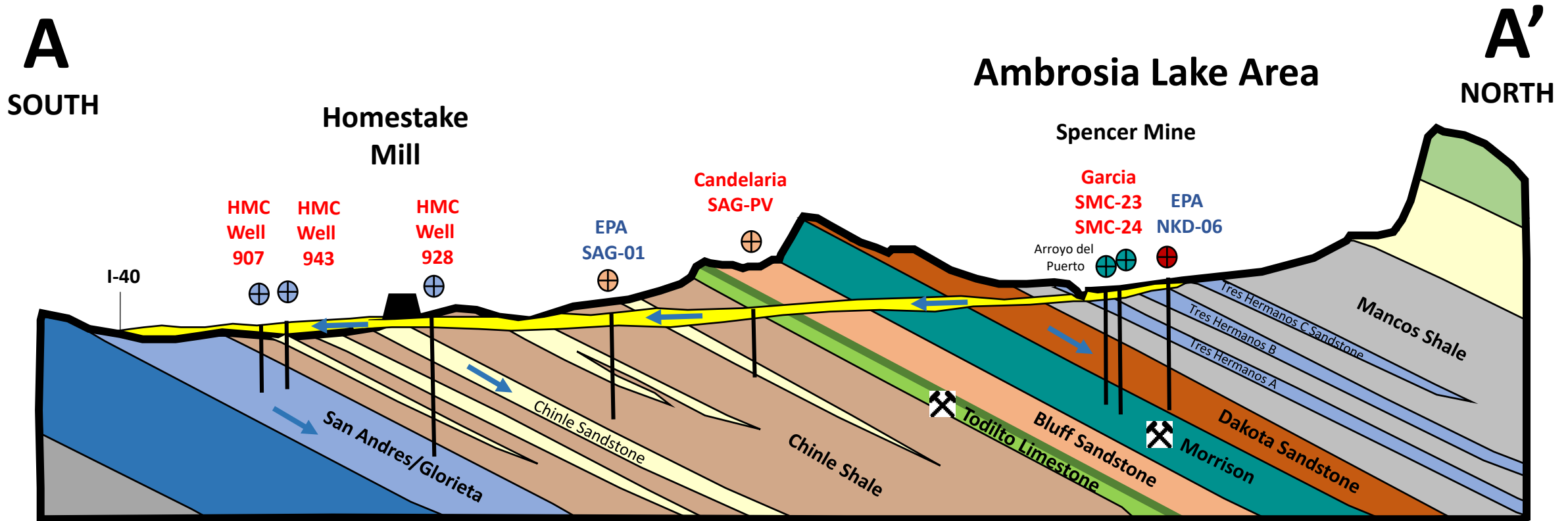
# SAN JUAN BASIN BEDROCK GEOLOGY



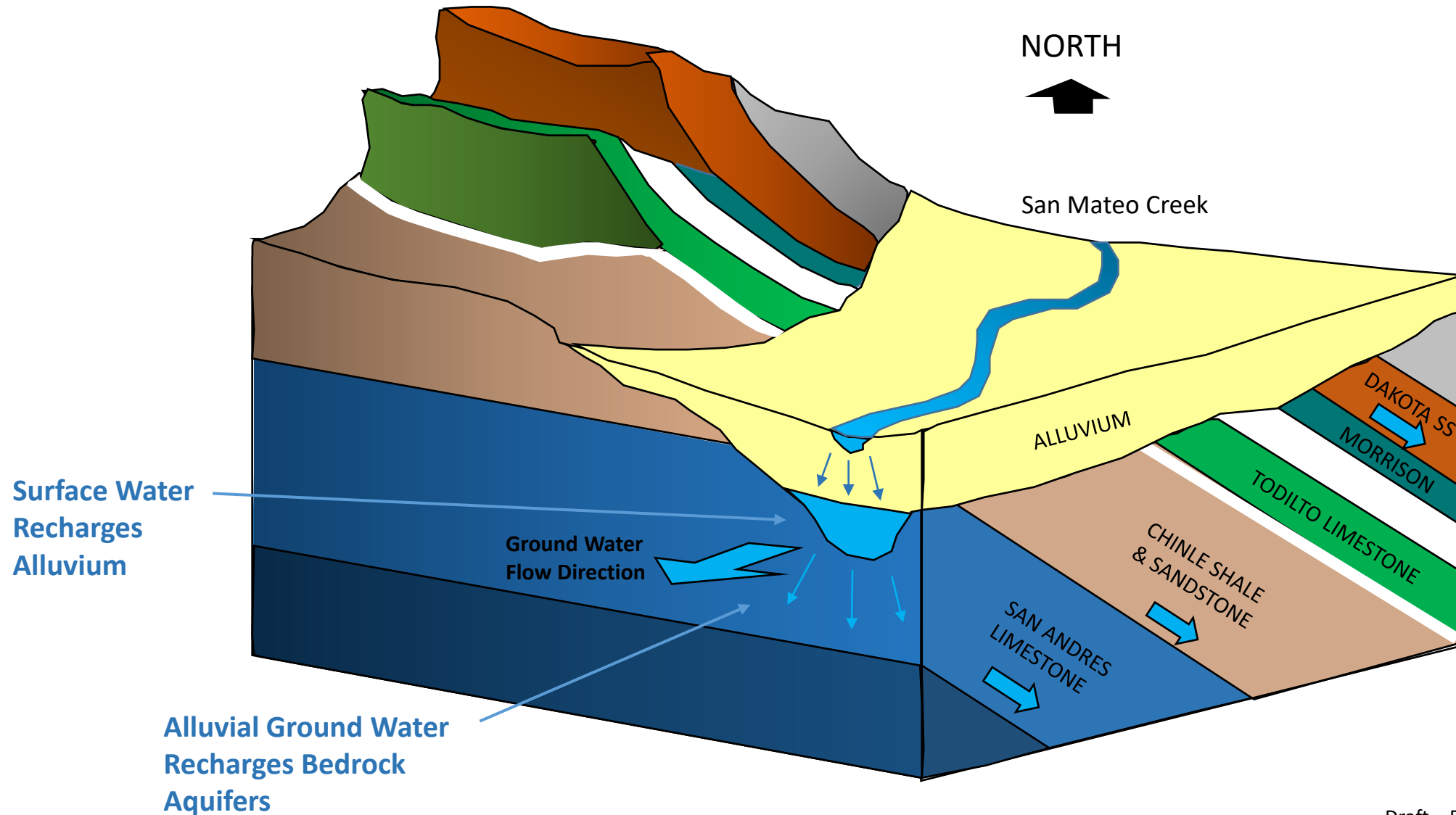


# CONCEPTUAL SITE GROUND WATER MODEL

## Generalized Cross Section Through San Mateo Creek Basin



# CONCEPTUAL SITE GROUND WATER MODEL





# EXPOSED AND TILTED BEDROCK FORMATIONS

San Mateo Creek Basin



# PHASE 1 COMPLETED

## ■ **EPA Phase 1 Ground Water Report**

- Completed in August 2016
  - Released to stakeholders in September 2016
- ### ■ Key components include:
- Historical studies on uranium mining impacts
  - Field investigation
  - Conclusions



# HISTORICAL STUDIES ON URANIUM MINING IMPACTS

- 1975 EPA study
  - Ground water contamination discovered
  - Sources – mine water discharge and tailing seepage
  - Perennial flows created in creeks/arroyos
- 1981 and 1986 New Mexico studies
  - Alluvial ground water exceeds standards
  - Mine water discharge rapidly infiltrates and saturates alluvium



1975 – Ambrosia Lake Area

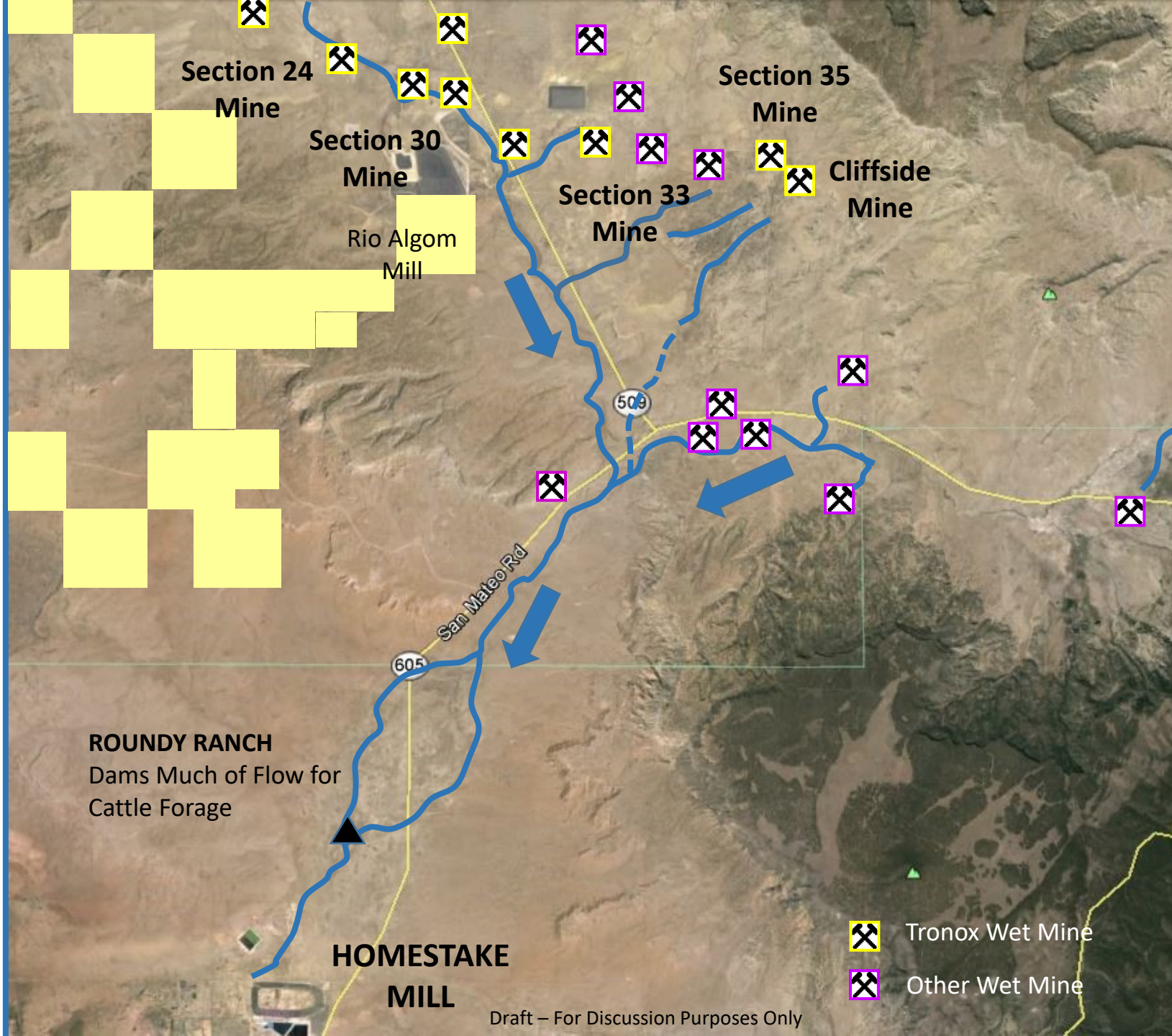
# SUMMARY OF HISTORIC MINE WATER DISCHARGE QUALITY

## Comparison to Alluvial Background Water Quality

Contaminant	1981 Mine Water Discharge Ambrosia Lake Area	1981 Mine Water Discharge San Mateo Area	1978-80 San Mateo Creek Upland Alluvial GW (Background)
Gross Alpha (pCi/L)	580	1,100	2.5 – 15.0
Uranium (mg/L)	2.4	0.080	0.005 – 0.010
Selenium (mg/L)	0.410	0.040	0.005 – 0.005
Molybdenum (mg/L)	0.79	0.32	0.005 – 0.010
Chloride (mg/L)	90	10	3 – 8
Sulfate (mg/L)	837	205	5-20
Total Dissolved Solid (mg/L)	1,690	520	125 – 300

New Mexico 1981 and 1986 Reports





# MINE WATER DISCHARGE

Artificially  
Created  
Perennial Flows  
Observed to  
Reached  
Homestake  
Impoundment  
(EPA 1980)



# MINE WATER DISCHARGE VOLUMES

1.0 Billion Gallons Discharged

2.6 Billion Gallons Discharge

3.9 Billion Gallons Discharged

12.5 Billion Gallons Discharged

2.2 Billion Gallons Discharged

2.6 Billion Gallons Discharged

4,200 gpm Discharged Water to San Lucas Canyon

Total Gallons Discharged Unknown

Section 22 Mine

Section 10 Mine

Section 12 Mine

Section 17 Mine

Bucky Mine

Section 13 Mine

Section 24 Mine

Section 23 Mine

Section 30W Mine

Section 30 Mine

Ann Lee Mine

Section 27 Mine

Phillips Mill

Section 35 Mine

Section 25 Mine

United Western Mine

Section 32 Mine

Section 33 Mine

Sandstone Mine

Cliffside Mine

Rio Algom Mill

Isabella South Mine

John Bully Mine

Spencer Mine

Johnny M Mine

Hogan Mine

Chill Willis Mine

Marquez Mine

Faith Mine

San Mateo Mine

San Mateo Mt. Taylor Mine

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# FIELD INVESTIGATION

San Mateo Creek  
Basin

- B** Background Boring/Well
- Dry Borehole
- New Monitoring Well
- Private Water Well
- Industry Monitoring Well

DOE Anaconda  
Bluewater  
Mill

Rio Algom  
Mill

Phillips  
Mill

Homestake Mill  
NPL Site

San Mateo

MT. TAYLOR

Alluvial Ground  
Water Flow Direction

Frontage Rd

Arroyo del Puerto

San Mateo Creek

Canyon Rd

122

40

Milan

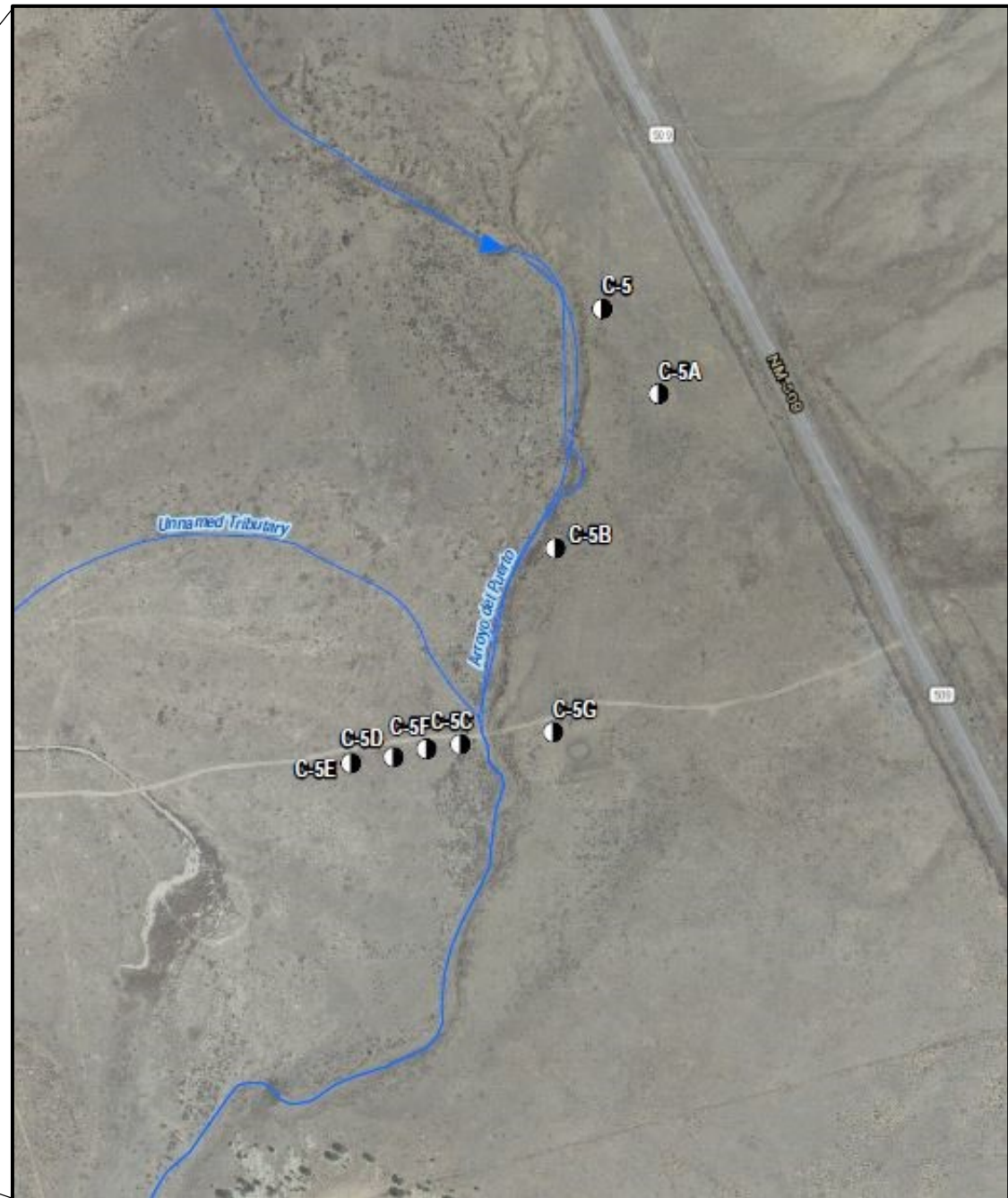
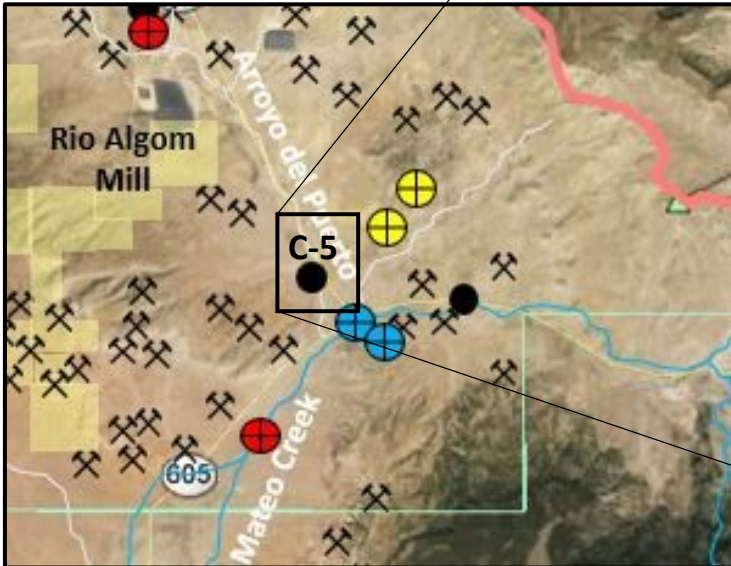
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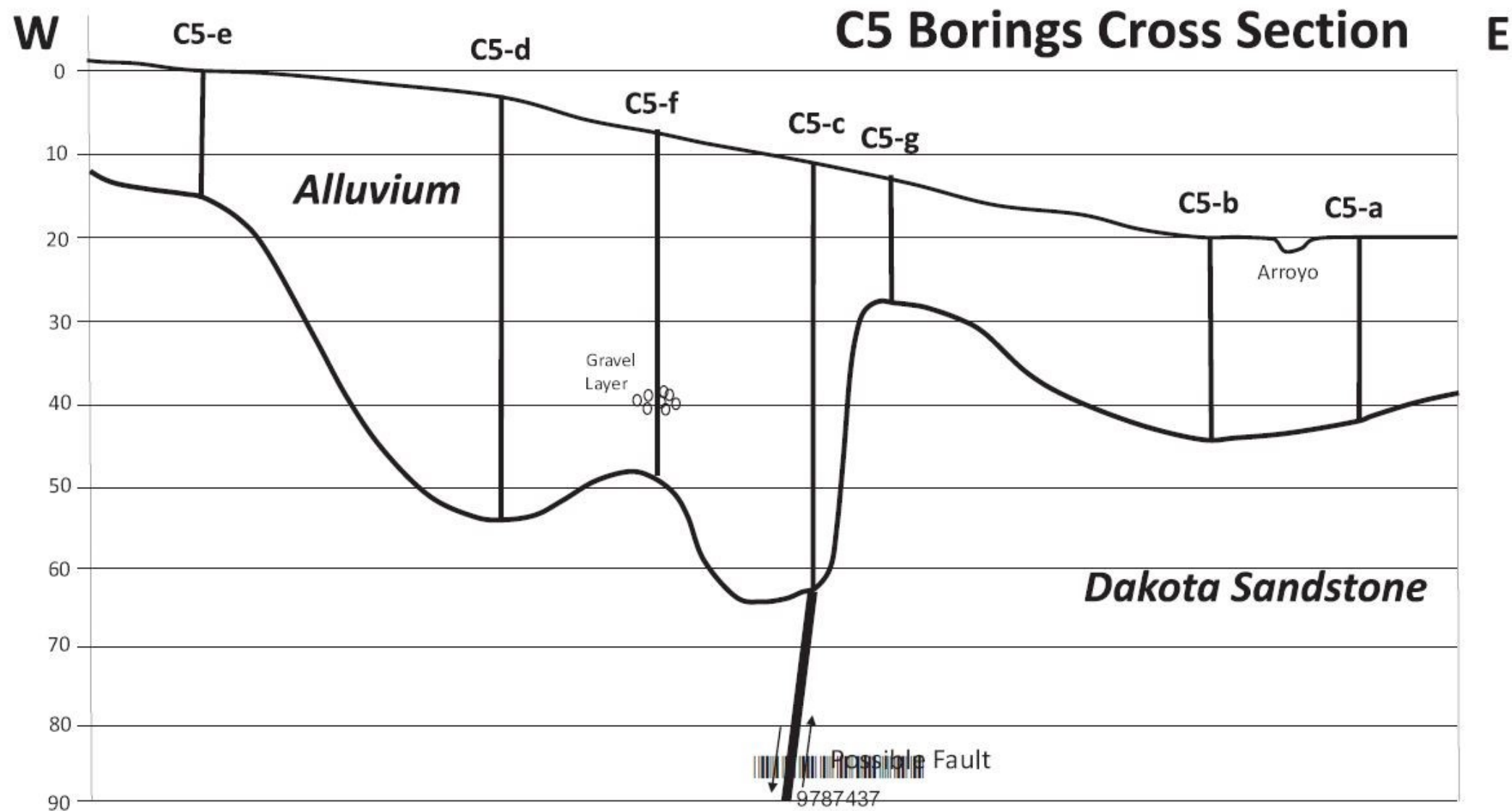
547

509



# MULTIPLE BORINGS DRILLED TO FIND ALLUVIAL WATER





# SUMMARY OF CONCLUSIONS

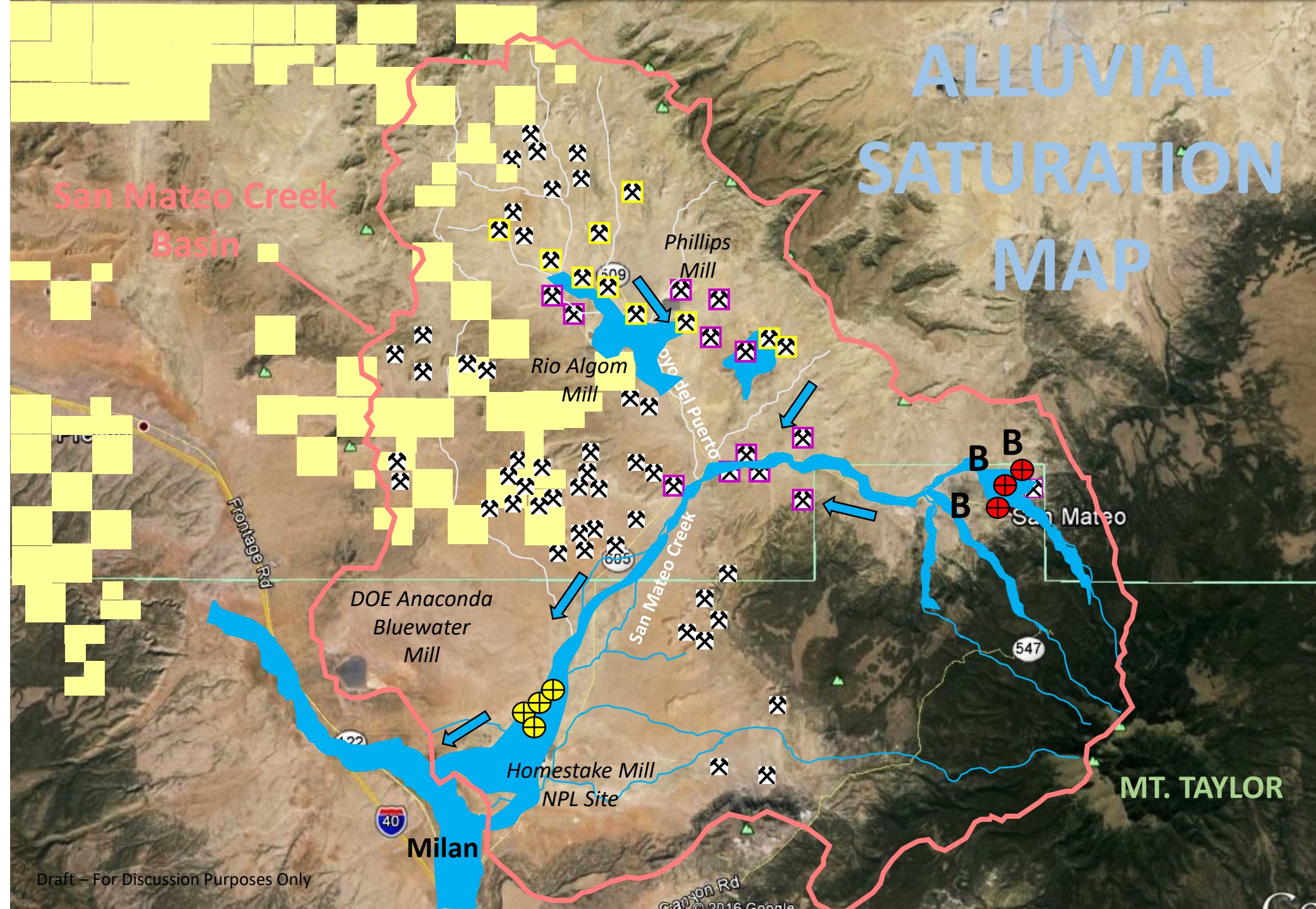
## Phase 1 Report

- Attempt to Characterize Alluvial Background had Mixed Results
  - Lack of Natural Saturation in Many Areas Investigated
- Alluvial Water Quality Varies Across Basin
  - Good quality upgradient of mines and mills
    - ✓ Meets standards
  - Poor quality downgradient of mines and mills
    - ✓ Exceeds standards
    - ✓ Similar to mine discharge water quality in some areas
- Mine Discharge Water Draining Through and Out of Alluvium



# ALLUVIAL SATURATION MAP

San Mateo Creek  
Basin





# ALLUVIAL WATER QUALITY MAP

San Mateo Creek  
Basin

39

10,000

Phillips  
Mill

Rio Algom  
Mill

Arroyo d

3,600

46

4,600

250

1,100

310

350

16

4

3

610

San Mateo

Frontage Rd

DOE Anaconda  
Bluewater  
Mill Site

110



2,200

Homestake Mill  
NPL Site

547

Uranium  
Total Dissolved  
Solids

MT. TAYLOR

-  EPA Background Well
-  Well Downgradient to Legacy Mines

16 Uranium (ppb)

16 Total Dissolved Solids (ppm)

 Alluvial Water

 Mine Water Discharge

# MASSIVE SATURATION AND DRAIN DOWN OF ALLUVIUM

- Caused by mine water discharges
- Water levels in central part of basin raised and dropped  
**OVER 50 FEET**
- Drain down not observed near Homestake



**A**

# CROSS SECTION A-A'

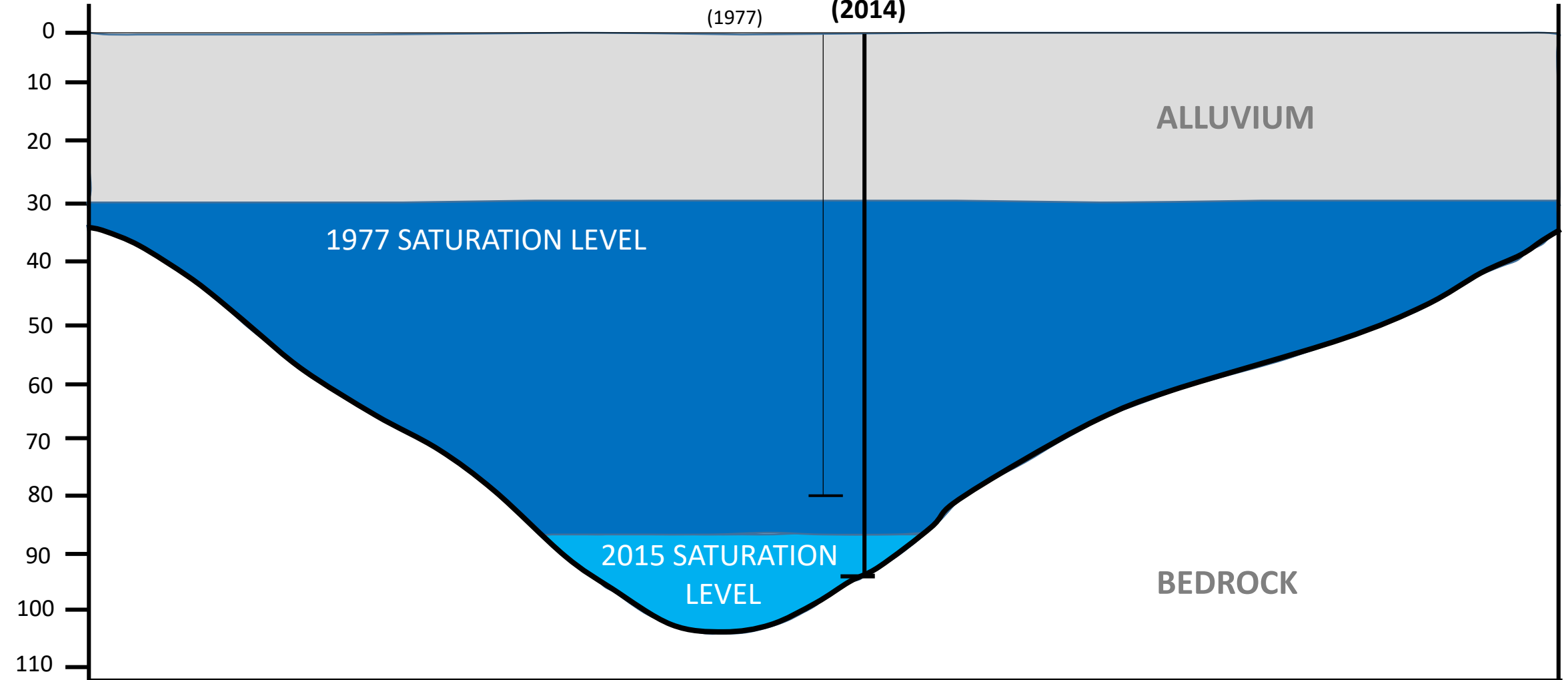
## CENTRAL SAN MATEO CREEK BASIN AREA

**A'**

West

East

Depth  
(ft)



# ALLUVIAL SATURATION 1960 est.

San Mateo Creek  
Basin

Phillips  
Mill

Rio Algom  
Mill

Arroyo del Puerto

C-3

San Mateo

DOE Anaconda  
Bluewater  
Mill

Homestake Mill  
NPL Site

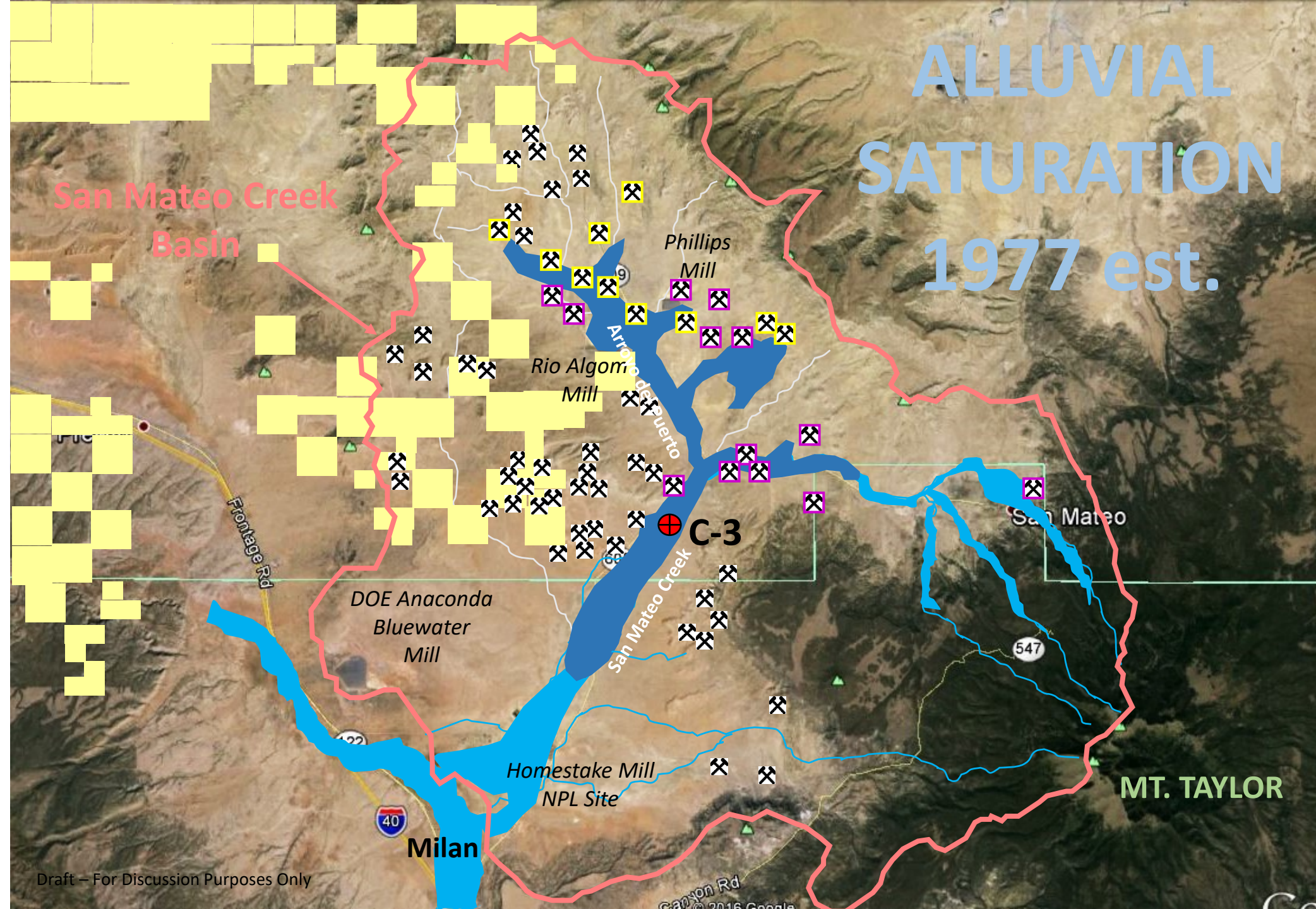
MT. TAYLOR

Milan



# ALLUVIAL SATURATION 1977 est.

San Mateo Creek  
Basin





**ALLUVIAL SATURATION 2015 est.**

San Mateo Creek Basin

Phillips Mill

Rio Algom Mill

DOE Anaconda Bluewater Mill

Homestake Mill

NPL Site

C-3

San Mateo Creek

Arroyo del Puerto

San Mateo

MT. TAYLOR

Milan

Frontage Rd

Canyon Rd

Highway 40

Highway 547

Highway 509

Highway 595

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**ALLUVIAL SATURATION 2015 est.**

**San Mateo Creek Basin**

Phillips Mill

Rio Algom Mill

Arroyo del Puerto

San Mateo

DOE Anaconda Bluewater Mill

Homestake Mill

NPL Site

Milan

Frontage Rd

San Mateo Creek

C-3

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San Mateo Creek Basin

Phillips Mill

Rio Algom Mill

DOE Anaconda Bluewater Mill

Homestake Mill NPL Site

Milan

Frontage Rd

Canyon Rd

Highway 40

Highway 547

Highway 509

Highway 595

San Mateo Creek

Arroyo del Puerto

San Mateo

MT. TAYLOR

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Homestake Mill NPL Site

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Highway 509

Highway 695

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San Mateo Creek Basin

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NPL Site

C-3

San Mateo Creek

Arroyo del Puerto

San Mateo

MT. TAYLOR

Milan

Frontage Rd

Canyon Rd

Highway 40

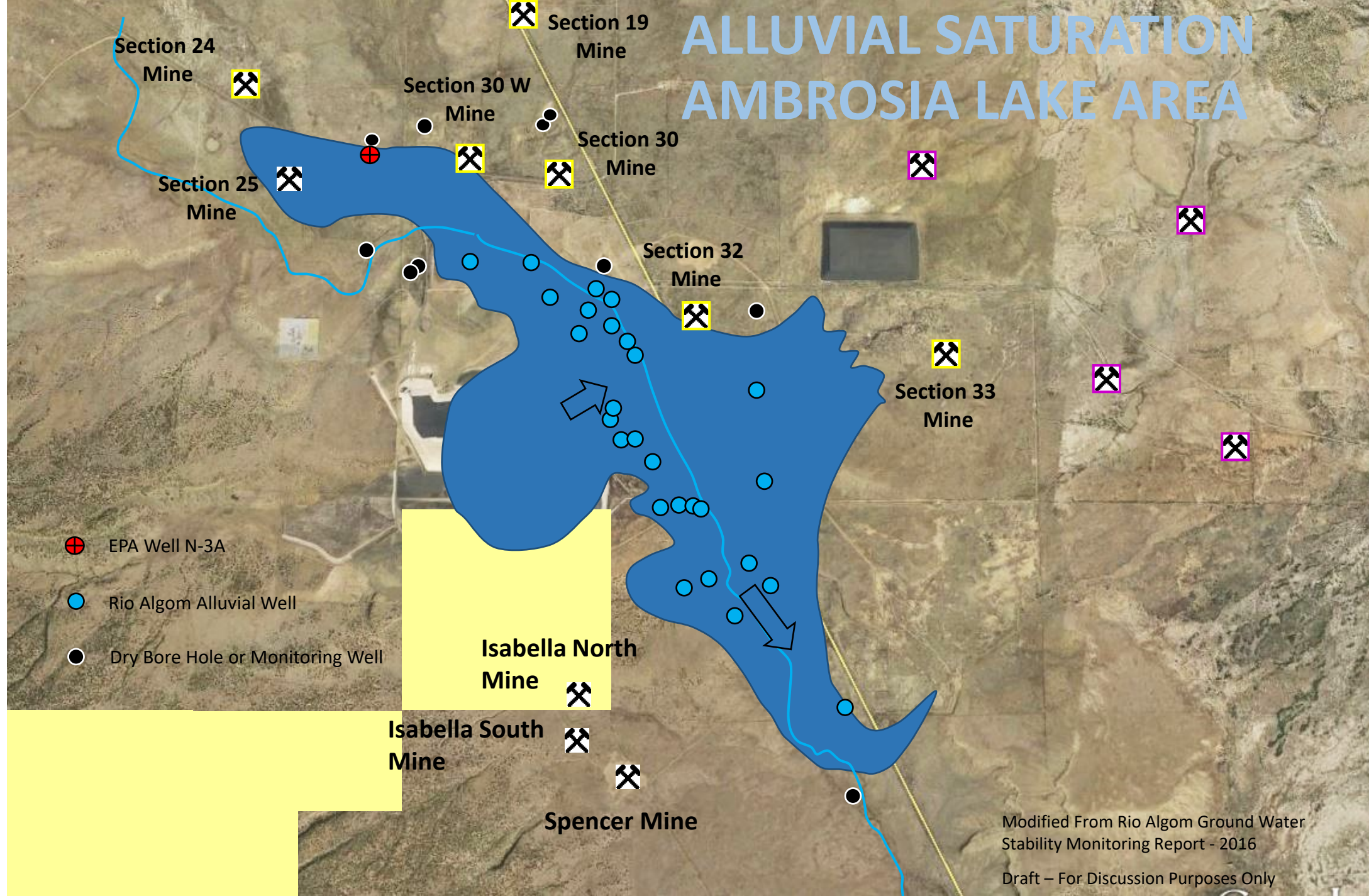
Highway 547

Highway 509

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# ALLUVIAL SATURATION AMBROSIA LAKE AREA



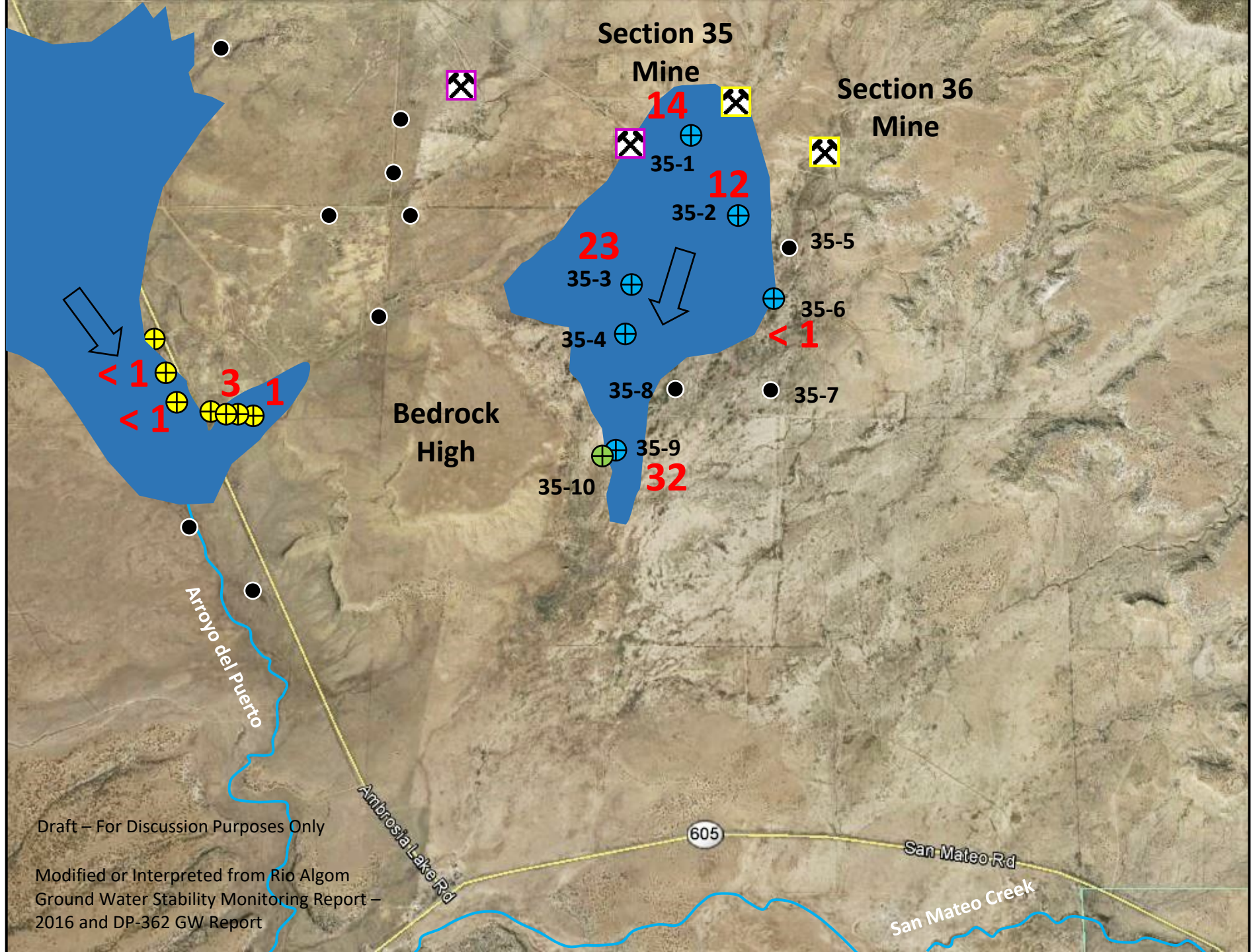
Modified From Rio Algom Ground Water  
Stability Monitoring Report - 2016

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# ALLUVIAL SATURATION SECTION 36 MINE AREA

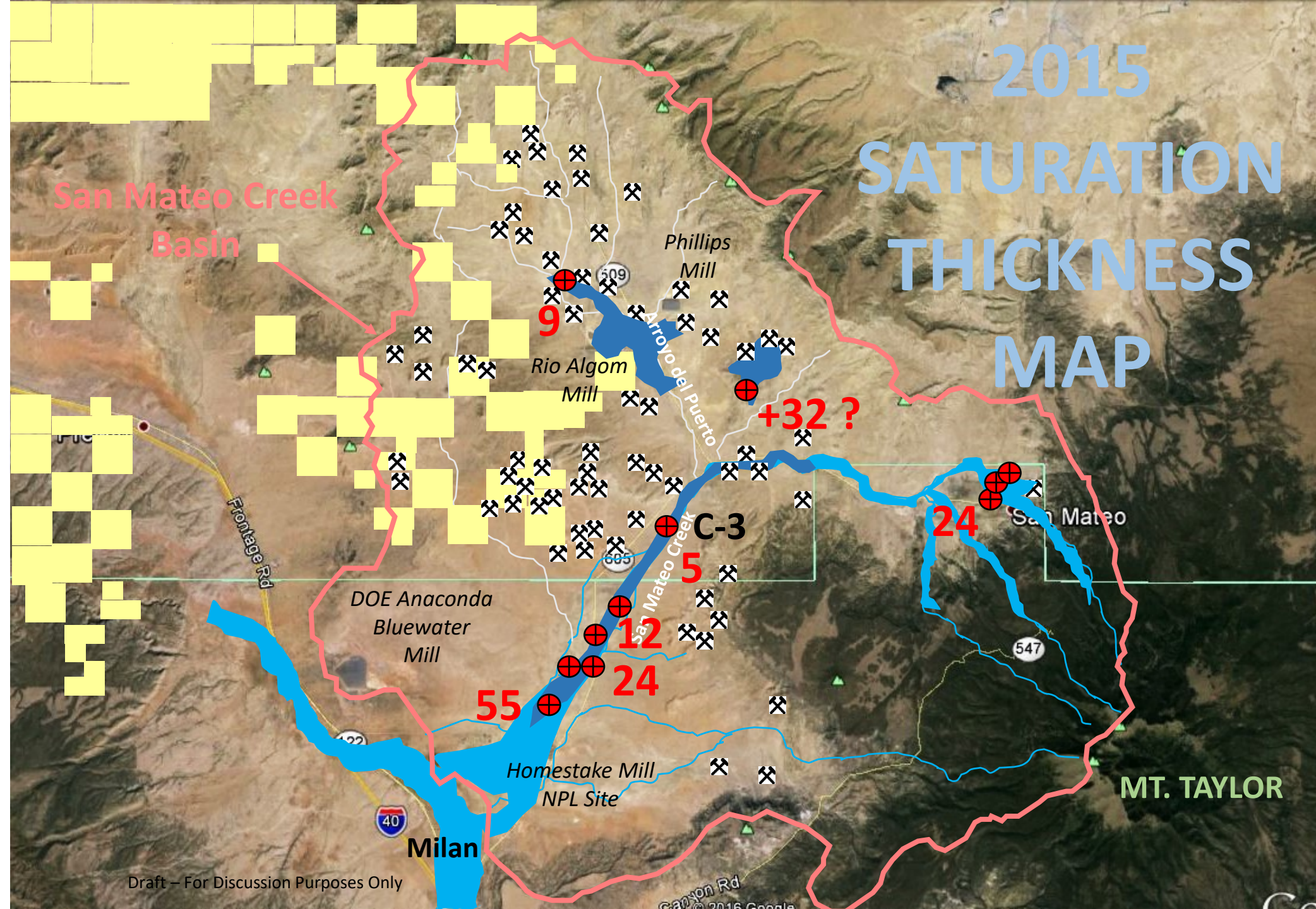
- 23** Saturation Thickness
- Dry Well
- ⊕ RAML Alluvial Monitoring Well – DP62
- ⊕ RAML Alluvial Monitoring Well – DP71
- ⊕ RAML Tres Hermanos C Monitoring Well





# 2015 SATURATION THICKNESS MAP

San Mateo Creek  
Basin



# STATUS OF PHASE 2 INVESTIGATION

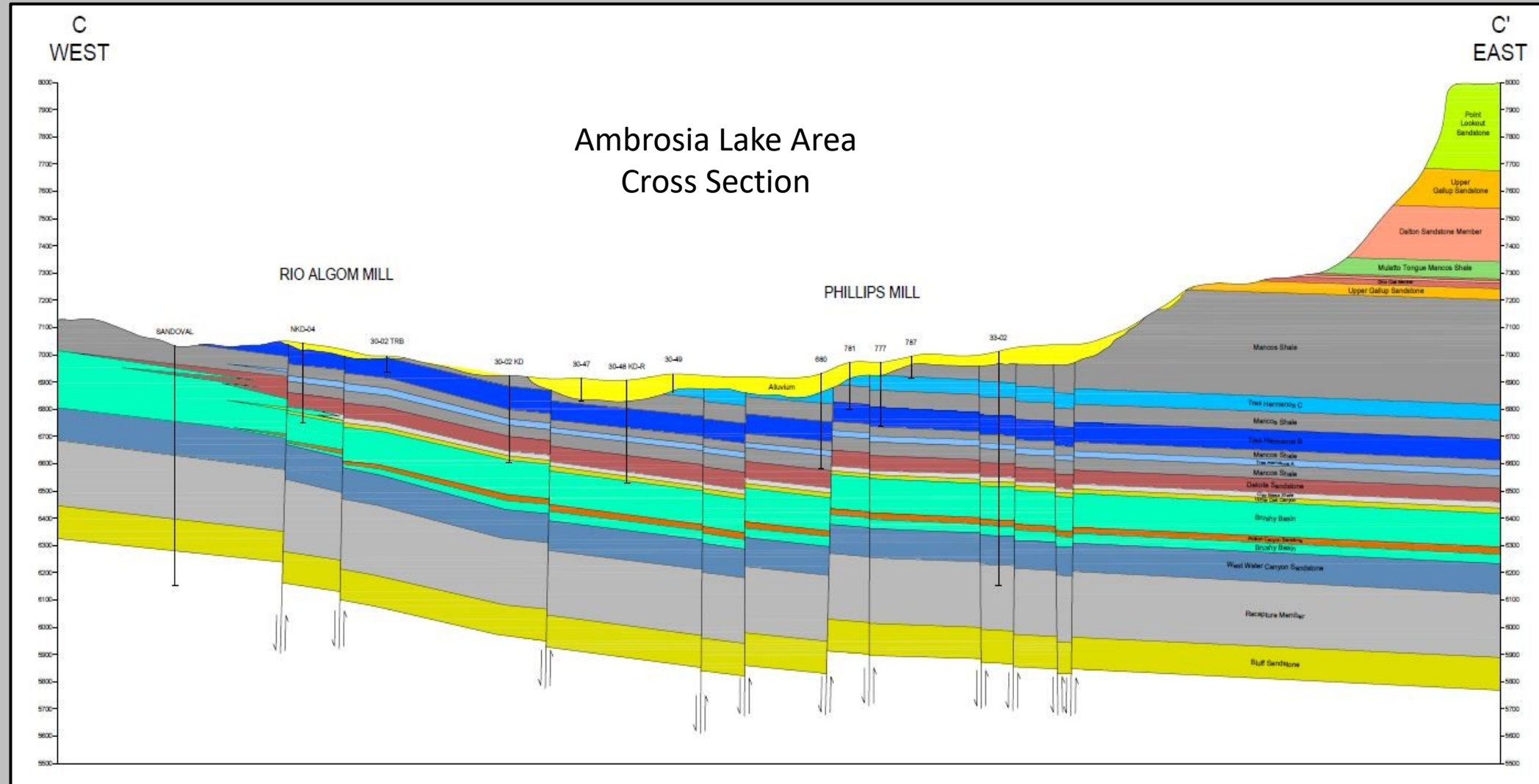
- Drilling/Sampling – 2015 to Early 2016
  - Focus on Dakota Sandstone – Ambrosia Lake Area
  - Alluvium – Central Basin
- Analytical Results – Summer 2016
- Data evaluation and interpretation – Ongoing
- Draft report preparation - Ongoing



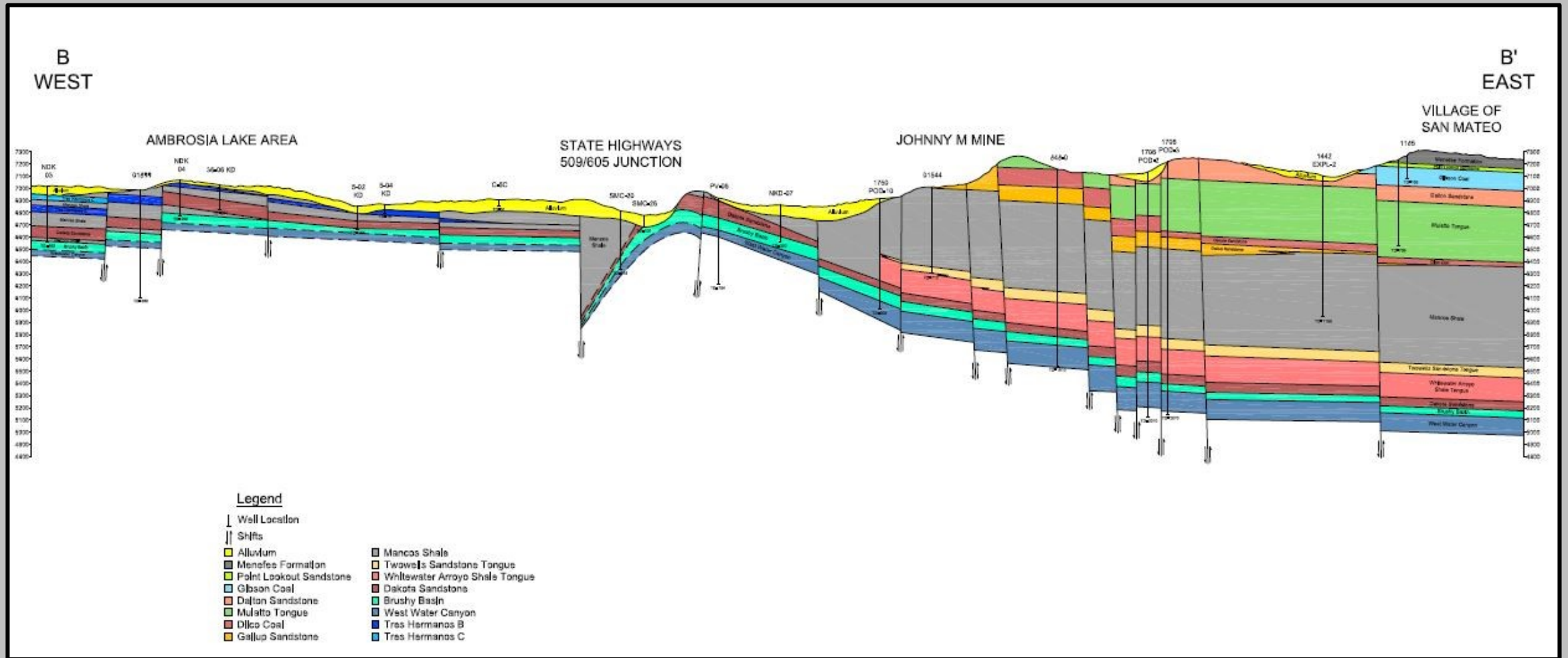
# CONTAMINANT MASS LOADINGS FROM MINES

1	Section 35 Mine, Ambrosia Lake, NM										
2	Mass of Uranium, Molybdenum, & Selenium discharged from 1960 to 1976 before NPDES treatment required										
3											
4	LOWER MINE WATER DISCHARGE RATE										
5		Discharge Period	Discharge Rate GPM	minutes per day	million gallons per day (MGD)	AVG COC concentration in mine effluent (MG/L)	Formula: lbs/day = dose X flow x 8.34 lb/gal	AVG POUNDS PER DAY (lbs/day)	AVG POUNDS PER YEAR	16 YEAR TOTAL POUNDS DISCHARGED	16 YEAR TOTAL TONS DISCHARGED
6	URANIUM	1960-1976	850	1,440	1.22	5.25	(5.25 MG/L) X (1.22 MGD) X 8.34 lb/gal	53.59	19561.39	312982.19	156.49
7											
8	MOLYBDENUM	1960-1976	850	1,440	1.22	1.91	(1.91 MG/L) X (1.22 MGD) X 8.34 lb/gal	19.50	7116.62	113865.90	56.93
9											
10	SELENIUM	1960-1976	850	1,440	1.22	0.02	(0.02 MG/L) X (1.22 MGD) X 8.34 lb/gal	0.20	74.52	1192.31	0.60
11											
12	HIGHER MINE WATER DISCHARGE RATE										
13		Discharge Period	Discharge Rate GPM	minutes per day	million gallons per day (MGD)	AVG COC concentration in mine effluent (MG/L)	Formula: lbs/day = dose X flow x 8.34 lb/gal	AVG POUNDS PER DAY (lbs/day)	AVG POUNDS PER YEAR	16 YEAR TOTAL POUNDS DISCHARGED	16 YEAR TOTAL TONS DISCHARGED
14											
15	URANIUM	1960-1976	2,618	1,440	3.77	5.25	(5.25 MG/L) X (3.77 MGD) X 8.34 lb/gal	165.07	60249.07	963985.13	481.99
16											
17	MOLYBDENUM	1960-1976	2,618	1,440	3.77	1.91	(1.91 MG/L) X (3.77 MGD) X 8.34 lb/gal	60.05	21919.19	350706.97	175.35
18											
19	SELENIUM	1960-1976	2,618	1,440	3.77	0.02	(0.02 MG/L) X (3.77 MGD) X 8.34 lb/gal	0.63	229.52	3672.32	1.84

# ONGOING PHASE 2 WORK



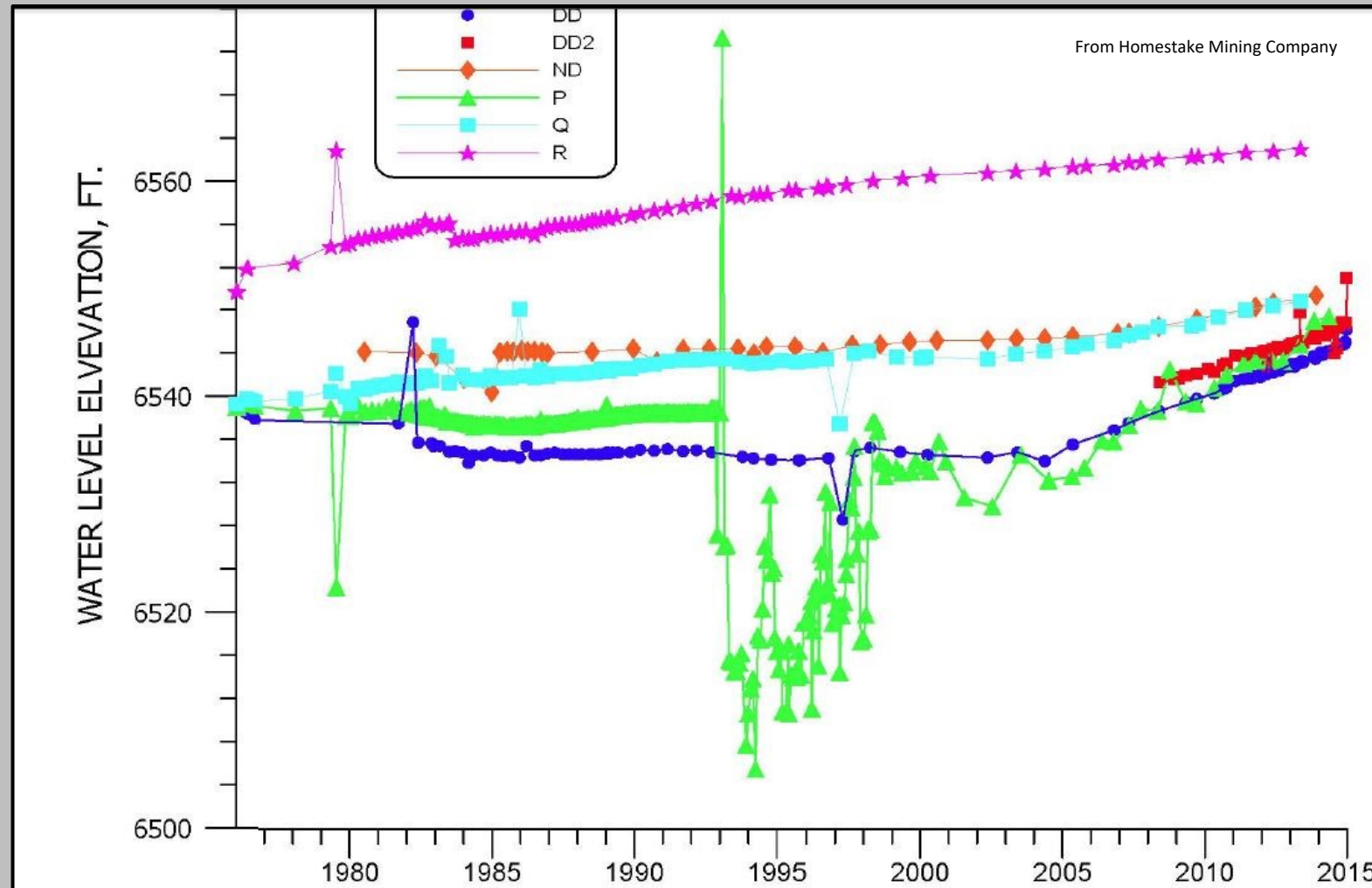




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# HISTORIC WATER LEVELS

## HOMESTAKE NPL SITE

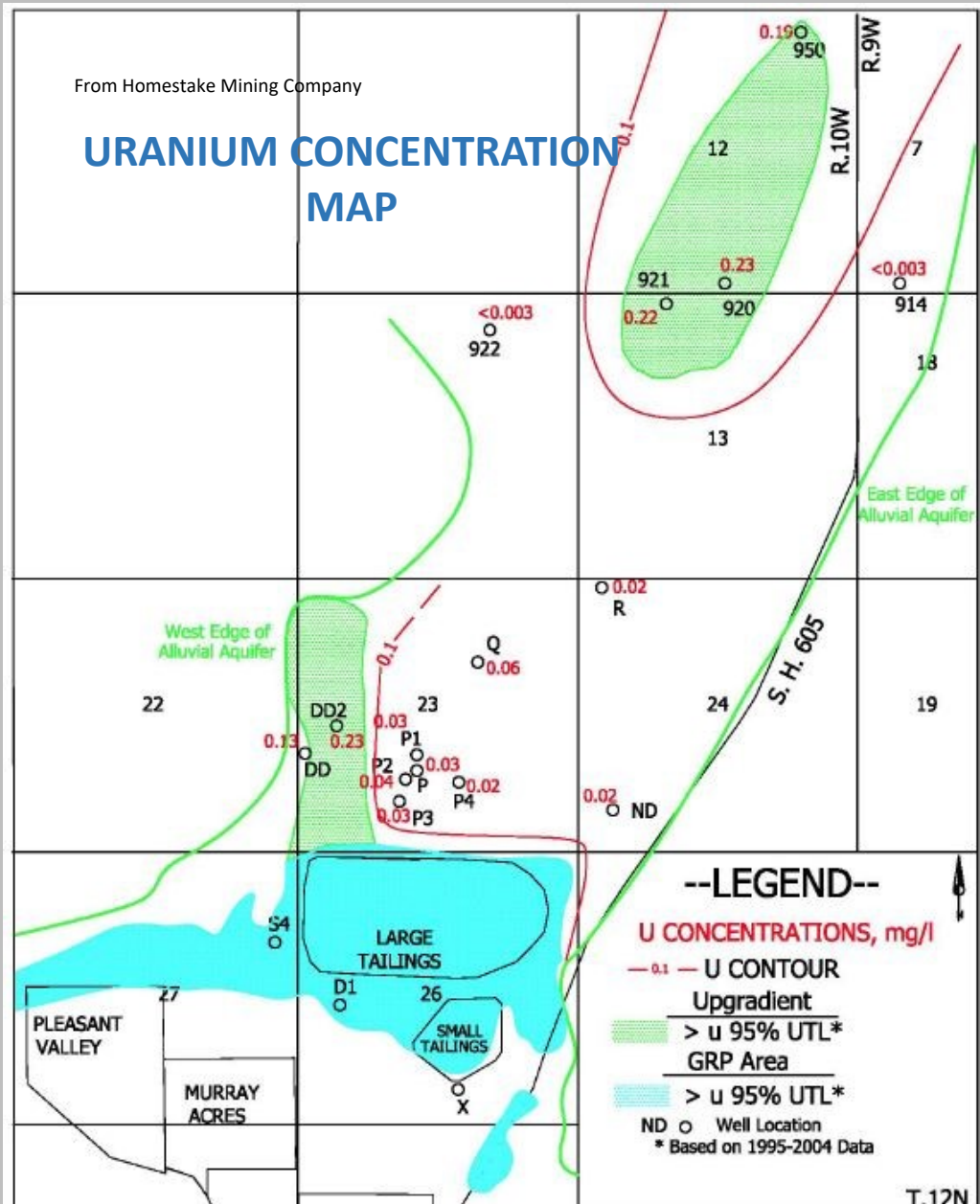




# HOMESTAKE NPL SITE

From Homestake Mining Company

## URANIUM CONCENTRATION MAP



T.12N

From Homestake Mining Company

## Uranium Concentration vs Time Plots

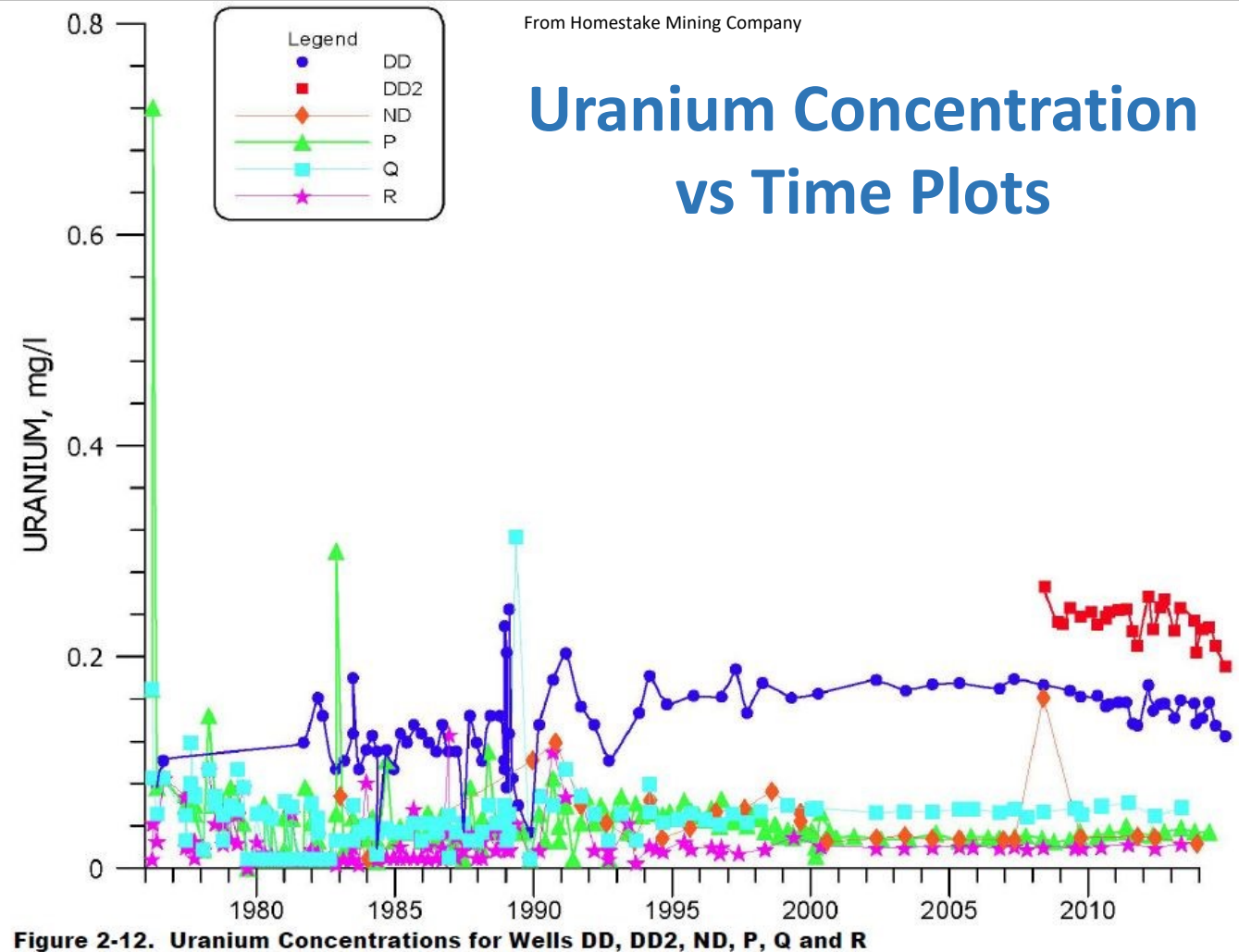
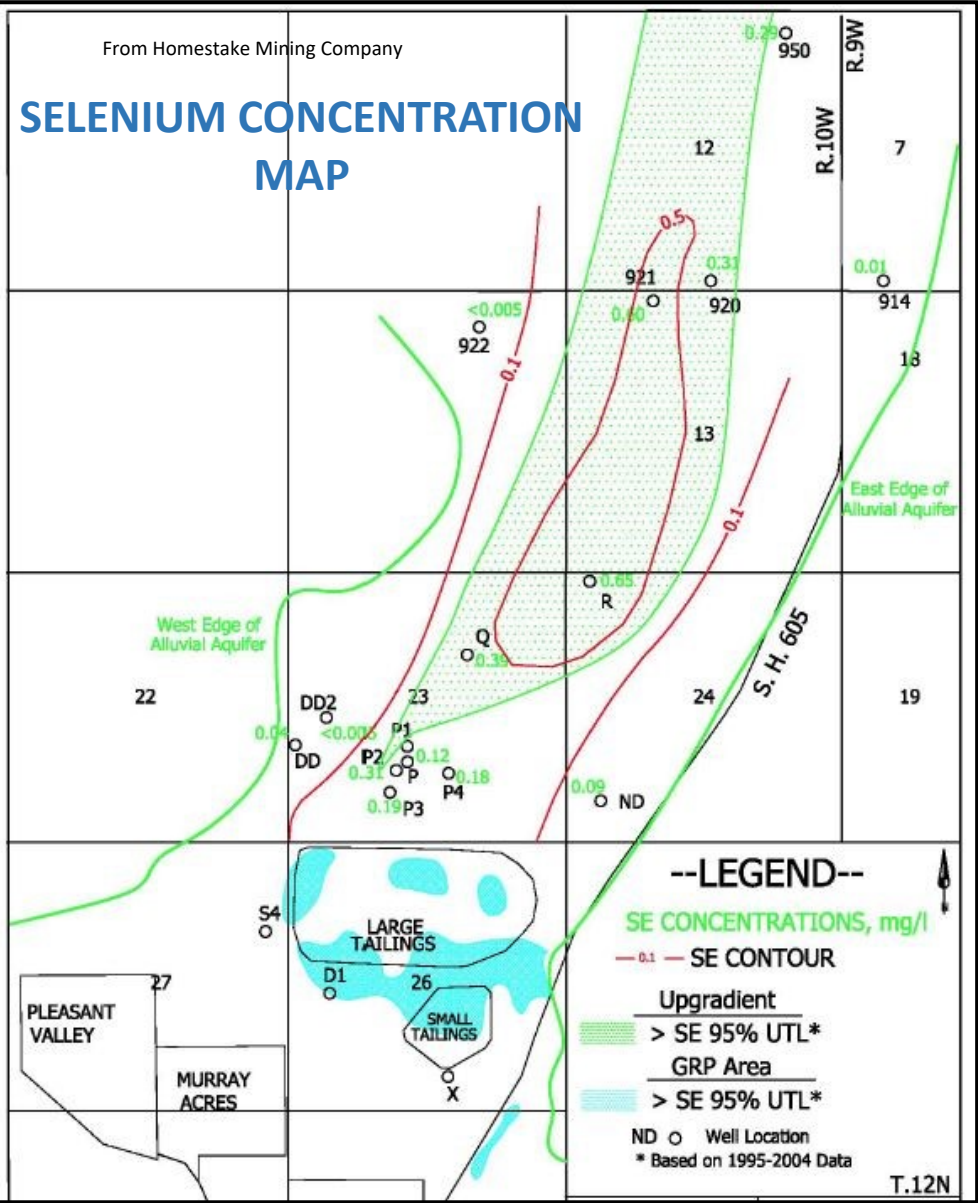


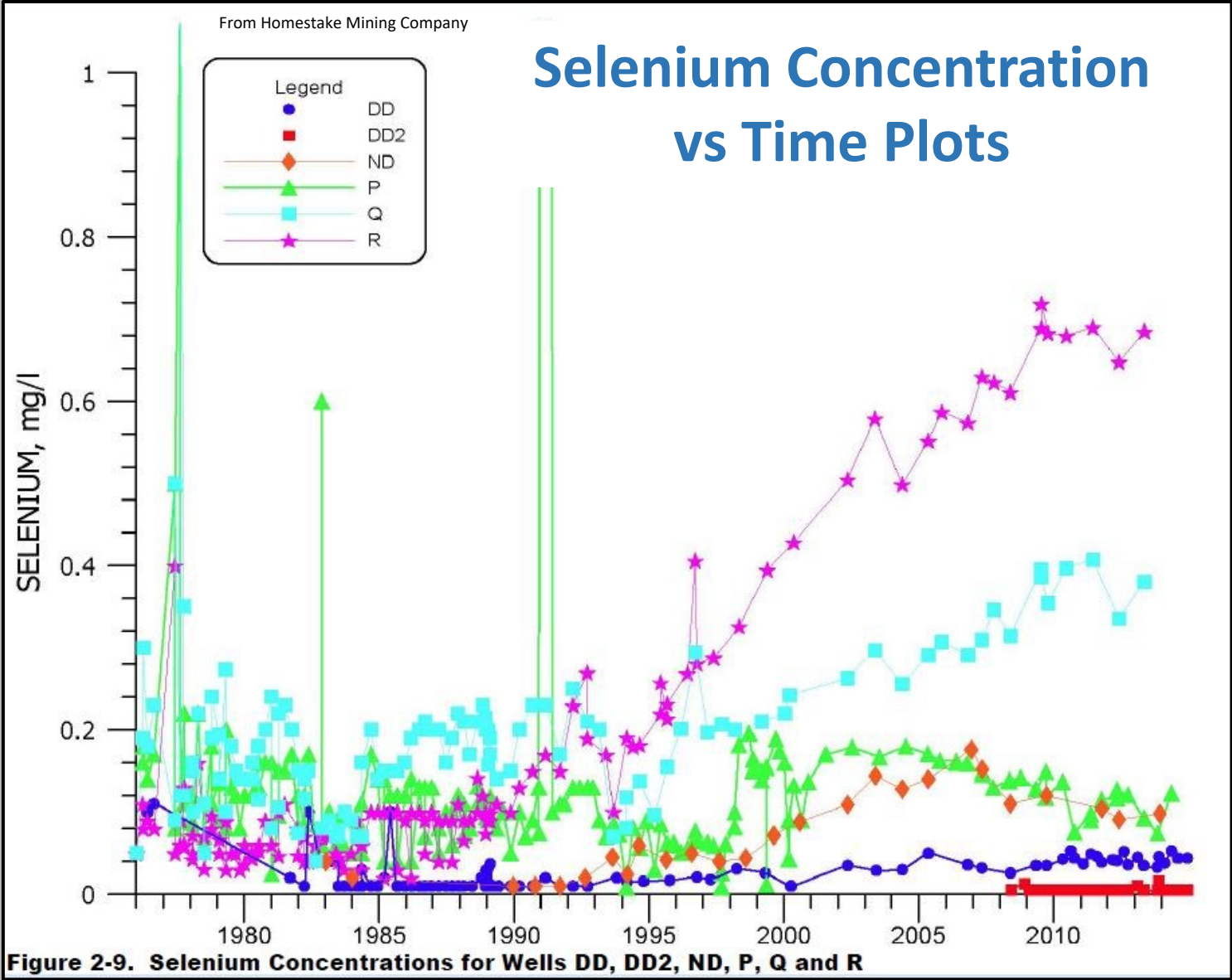
Figure 2-12. Uranium Concentrations for Wells DD, DD2, ND, P, Q and R

# HOMESTAKE NPL SITE

## SELENIUM CONCENTRATION MAP



## Selenium Concentration vs Time Plots





# PLANNED ACTIVITIES FOR GROUND WATER INVESTIGATION

